

# Nicholas B. DeFelice

Drinking Water Risks to Health 40 Years After Passage of the Safe Drinking Water Act: A County-by-County Analysis in North Carolina

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The advent of community water services was one of the greatest public health advances of the twentieth century, yet disparities in the quality of water may persist and may reflect similar disparities in health outcomes. These disparities have not yet been investigated in North Carolina, home to 2120 community water systems (CWSs) and tens of thousands of domestic water systems (DWSs). This study used novel quantitative methods to compare North Carolina's statewide health outcomes associated with drinking water quality at a county level to estimate the magnitude and spatial variability of cancer attributable to chemicals in CWSs along with acute gastrointestinal illness (AGI) attributable to microbial contamination of drinking water.

Using a stochastic risk model we examined the cancer risks attributable to chemical exposure through drinking water for all chemicals covered under the Safe Drinking Water Act (SDWA) in North Carolina. Of the 67 contaminants, three (total trihalomethanes, arsenic and alpha radiation) dominated the cancer risk, suggesting opportunities may exist to streamline SDWA enforcement by reducing the monitoring requirements for low-risk chemicals and focusing on high-risk chemicals. We estimated that 368 (95% CI 225-498) cancer cases are potentially attributable to TTHMs, 15 (95% CI 3.9-65) to arsenic, and 12 (95% CI 2-45) to alpha particle radiation. We also characterized the magnitude and spatial variability of AGI cases attributable to microbial contamination of CWSs. We compared three approaches (population intervention model, drinking water attributable risk, and quantitative microbial risk assessment) to estimate the percentage of emergency department visits for AGI attributable to microorganisms in North Carolina CWSs. Of the three models, the population intervention model had the highest internal validity and is therefore the most informative for decision making, since risks associated with exposure are specific to the local population.

Finally, using the population intervention model we compared the burden of AGI attributable to CWSs with that attributable to DWSs. In total, an estimated 46,690 (95% CI 32,800-60,800) annual cases of AGI were attributable to microbial contamination in drinking water, constituting approximately 11.4% (95%CI 8.0-14.8) of all ED visits for AGI. We determined that each 10% shift in the percentage of the county population from DWSs to CWSs could reduce emergency department visits for AGI by 1.4%. Providing regulated water to current DWS users may provide substantial health benefits.

## **Committee:**

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